Assessment of prestressing effect in existing concrete bridges

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1. Introduction

The first generation of precast girders were post-tensioned and transformed into an orthotropic slab using transversal post-tensioning. Currently, still about third of existing precast bridges built with this concept we have been using in service. The consequences of a deficient conceptual design and an inadequate maintenance will be shown using practical examples of two precast bridges under emergency condition close to collapse state. Structural defects and possible brittle character of collapsing were found on some girders. Fortunately, early closure of those bridges has prevented the fatal consequences. Detailed structural analysis and in-situ investigation and testing have been performed on those structures. As the main factors of superstructure failure we can identify corrosion of the prestressing wires, very bad condition of anchors protection and absence of grouting. Abstract summarizes the findings from testing and analysis of those girderes. The results can help to assess the usability of similar bridge structures in future.

2. Characteristic failures of bridges

In a recent period were declared state of emergency on two of precast prestressed concrete bridges crossing the river Orava on the international route I/59 closed the villages Podbiel and Nizna at north part of Slovakia. The emergency state was declared due to the serious failures on the bearing structure were detected. The first generation of prestressed bridges made of precast elements began to be applied more extensively in the former Czechoslovakia during the 1950s to 1960s. The actual technical condition of the observed bridges has been manifest as the cause of the initial “childhood diseases” of building technology. As the main source of the failure state of this type has been total insufficient protection of prestressing reinforcement and anchors. For example, tendons were found very poor grouted and anchors were detected with insufficient or none concrete sheathing, see Fig. 1a). All these facts had been the crucial influence to the large deformation rising or wide crack opening in the girders, Fig. 1b).

Detected structural failures had been depended to the actual prestressing level as we know. To define the actual prestressing force in existing structures is very difficult task. Generally there are available any kind of destructive or non-destructive method but still complicated to use. We had used analytical and experimental approach in the form of Structure Response Method. In this abstract, we would like to present the results of performed testing method of prestressing, based on the fully scaled loading test and numerical analyses of deteriorated structure. Some result can be seen on prestressed girder on the Bridge Podbiel, Fig. 2.

Figure 1a). No sheathing on the anchors – Bridge Nizna

Figure 1b). Crack in the girders - Bridge Podbiel

3. Testing and analysis

One girder in relatively good technical condition was separated from orthotropic bridge deck (bridge Podbiel) and was full-scaled tested. There was obtained about 18 % reduction of assumed prestressing force in the girder.

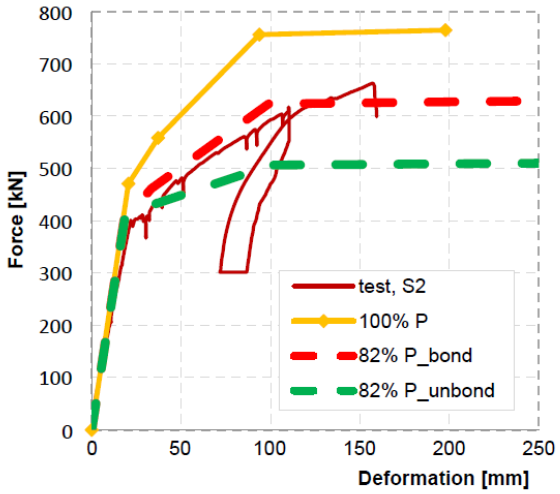

Figure 1. Bridge Podbiel - reduction of prestressing force in girder about 18%.

Acknowledgements

This research work was supported by the Slovak Grant Agency under contract No. 1/0045/19.

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